The Natural History of Clay. By ALFRED B. SEARLE.

The Origin of Earthquakes. By CHARLES DAVISON.

Rocks and their Origins. By GRENVILLE A. J. COLE.

The Modern Locomotive. By C. EDGAR ALLEN.

Considering that high general level of excellence, together with the very moderate prices, it would seem that almost any public library or large high school would do well to obtain both series. The treatment, usually different from that of the conventional text-book, is likely to interest many readers, some in one subject, some in another. There is not as much duplication in the two series as some of the titles might suggest; thus "Anthropology" and "Man" in the one do not at all take the place of "Prehistoric Man" in the other.

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On the Foundation and Technic of Arithmetic. By GEORGE BRUCE HALSTED. Chicago, The Open Court Publishing Company. 1912. Pp. 133.

The main purpose of this book is to place the number concept of modern mathematics within easy reach of the teacher in the grades. That there is reason for the existence of such a text is apparent from the fact that people in general and to some extent even teachers of arithmetic still look upon mathematics as "the science of quantity." The primitive number concept of modern mathematics has nothing to do with quantity. Mathematical research on this subject has been slow in commanding the attention of non-mathematicians. It is not very many years ago that a prominent American psychologist published a book in which the simple act of "counting" was declared to be an act of "measuring." It is not very long since, that a series of arithmetics was published in which the primitive idea of number was presented as being that of "ratio." Dr. Halsted brings out clearly and strongly the fact that primitive number, whether considered from the standpoint of its modern logical exposition, or from its historic development, is wholly divorced from measurement, and that number viewed as a ratio presupposes counting and is a more involved concept. The book under review contains an able presentation of fundamental concepts. This every one familiar with Dr. Halsted's earlier works had reason to expect.

The leading topics discussed in the book are as follows: The genesis of number, counting, genesis of our number notation, addition, multiplication, subtraction, division, decimals, fractions, measurement, mensuration, order, ordered sets, ordinal number, the psychology of reading a number, arithmetic as a formal calculus, suggestions on the teaching of arithmetic.

Halsted makes the interesting observation that, besides the "ordinal number" and "cardinal number," modern civilization has introduced "nominal number" used as a proper noun, as in the telephone service. "Since the size of the number and its place in the number series are here alike irrelevant, the whole stress falls upon its recognition as a unique name."

The text contains numerous historical statements, some of which are open to criticism as not embodying the latest researches. Moreover, there is a frequent lack of bibliographical reference to authorities. Thus Halsted gives $\pi = 3.14+$ and $\pi = 3.1416-$ and then adds:

> This is historically the first meaning of the signs + and —, which arose from the marks chalked on chests of goods in German warehouses, to denote excess or defect from some standard weight.

In view of the fact that historians have been in doubt as to the exact origin of + and —, the authority for Halsted's categorical statement would be interesting. Cantor[1] and Tropfke[2] both express themselves with great reserve on the validity of the explanation endorsed by Halsted. Eneström in a later re-

[1] Cantor, "Geschichte der Mathematik," Vol. II. (2), 1900, pp. 230, 231, 320.

[2] J. Tropfke, "Geschichte der Elementar-Mathematik," Vol. I., 1902, p. 134.

search arrives at more positive results, indicating a different origin for +. He shows that in Widman's printed arithmetic of 1489, + had not yet become a purely mathematical sign, that with Widman + meant simply "und" (and), in conformity with a practise of the middle ages, according to which a symbol closely resembling + was used for "et."[3] It is now known that Widman possessed a manuscript algebra in which + is used for "et," even in cases where "et" does not mean addition.[4] Widman in 1849 sometimes indicated subtraction by the special symbol —, a usage found somewhat earlier in a Dresden manuscript of the year 1481.

Halsted attributes decimal fractions to Stevin (1585), but makes no mention of the earlier use of decimals by Vieta[5] (1579) and Rudolff[6] (1530). Halsted mentions Napier (1617) as the first to use the decimal point, but the period (or the comma) was used by Bürgi as early as 1592,[7] by Prätorius in 1599[8] and by Kepler in 1616.

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Treatise on Light. By Christiaan Huygens. Rendered into English by Silvanus P. Thompson. London, Macmillan & Company. 1912. Pp. vii + 128.

Ever since its birth, in 1690, the wave theory of light has been adapting itself to environment. Just at the present moment, when the completeness and perhaps the competency of the wave theory is being called in question by certain phenomena of radiation and radioactivity,[1] an English translation of Huygens's great "Treatise on Light" is particularly opportune. The fact that this translation has been made by Professor Silvanus P. Thompson is an ample guarantee that it has been done in a scholarly and sympathetic manner. Two distinct courses are open to one who wishes to transfer into English the thought of a foreign author who lived more than two hundred years ago—either he may employ the English phraseology of our own day, or he may use that which he conceives to have been the current diction of the period in which the work was composed. In either case he must avoid anachronisms, and in either case the problem is difficult. So many modes of expression are common to the languages of western civilization and so many of these forms have disappeared from our language during the last two hundred years, that a certain quaintness is inevitably given to any translation of old French, German, or Italian, in which particular pains is not taken to avoid these obsolete phrases. It is the second of these alternatives which Professor Thompson has chosen. The result is that the volume including its title page, table of contents, text, paper, binding, typography, size, and English style, is as nearly as possible what it would have been if Huygens had lived and worked and published on the other side of the English Channel. This is not to be understood as meaning that the translation is in any sense a literal one, for it is precisely the spirit of the work which Professor Thompson has caught and has faithfully reproduced. In brief the volume is in every way worthy of the great contributions to science which it contains. The first three chapters in which Huygens's principle is enunciated had already been made available to English readers through *Harper's Scientific Memoirs.* But the full evidence for Huygens's principle can only be obtained by understanding Chapters 4, 5 and 6. Atmospheric refraction is explained in Chapter 4 practically as we have it to-day. In Chapter 5 the wave sur-

[3] *Bibliotheca mathematica,* 3 F., Bd. 9, 1908–09, pp. 155–157, 248.

[4] *Bibliotheca mathematica,* 3 F., Bd. 10, 1909–10, p. 182, 183.

[5] *Bibliotheca mathematica,* 3 F., Bd. 11, 1911, p. 340.

[6] *Bibliotheca mathematica,* 3 F., Bd. 10, 1909–10, p. 243.

[7] *Teachers College Bulletin,* 1910–11, No. 5, p. 19.

[8] Cantor, *op. cit.,* Vol. II. (2), 1900, p. 619.

[1] W. H. Bragg, evening discourse before the British Association at Dundee, *Nature,* 90: 559 (1913); R. A. Millikan, vice-presidential address before the American Association for the Advancement of Science, *Science,* January, 1913.